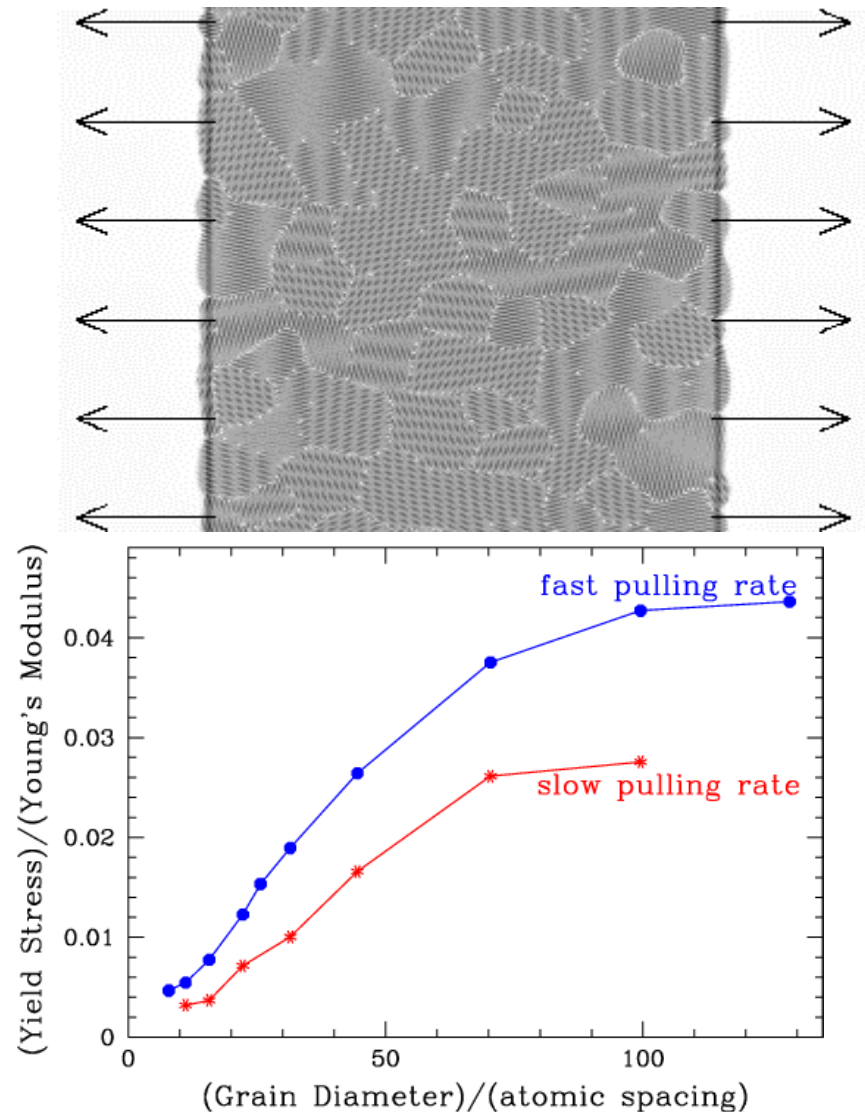


The Strength of Nano-Crystalline Materials

Ken Elder, Oakland University, DMR-0076054

Material properties are often controlled by complex micro-structures that form during non-equilibrium processing. A striking example of this occurs in polycrystalline materials, where the stress required to significantly deform the material (i.e., the 'yield stress') is strongly dependent on the average size of the polycrystalline grains. Recently, due to the increasing importance of nano-technology, there has been a great deal of interest in the yield strength of nano-crystalline materials. For this reason we developed a new method for studying such properties at realistic strain (or pulling) rates. This work predicts that the yield stress decreases with decreasing grain size in agreement with recent experiments in Cu, Pd, NiW and NiP.



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Future Work

This work will be extended to consider the influence of concentration variations on material strength. A preliminary simulation of the solidification of a polycrystalline eutectic material is shown on the right.

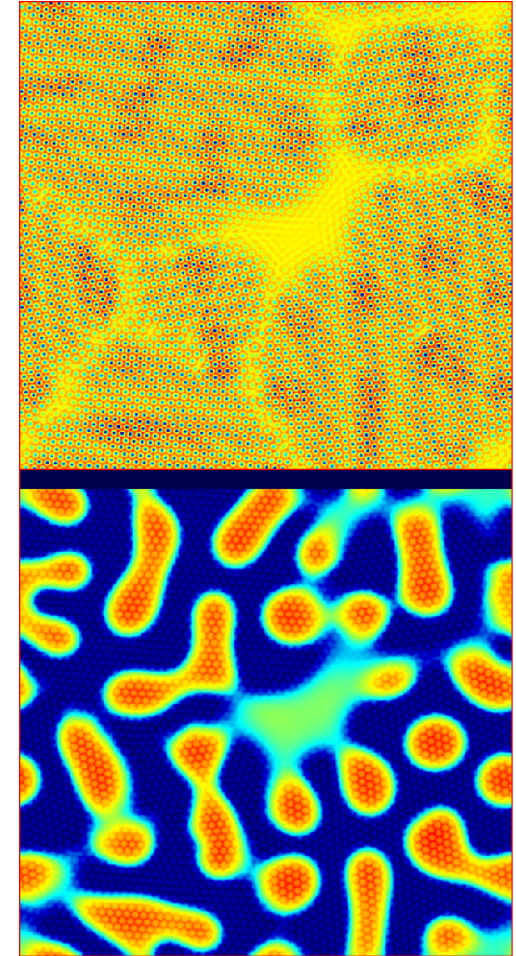
Collaborations

This research has included collaborations with two undergraduate students, Mark Katakowski and Joel Berry, (Oakland U.), one graduate student, Mikko Haataja (McGill U.) and faculty members Martin Grant (McGill U.) and Nikolas Provatas (McMaster University). Mark is currently working on a PhD in medical physics at Oakland University, while Joel will enter a graduate program at McGill University. After completing his PhD, Mikko has worked as a postdoctoral fellow at Princeton and McMaster Universities.

Dissemination of Results

Recent invited presentations: CSCAMM Workshop, College Park MD, 10/28/03; Oakland U. 10/21/03; Argonne National Lab, 07/01/03; Wayne State U., 04/08/03; TMS Annual Meeting, 03/05/03; McMaster U., 01/20/03; Northwestern U., 11/19/02.

Publications: Physical Review Letters, 88, 245701 (2002), Physical Review E, submitted.



Eutectic Crystallization

The color scale in the upper and lower figures corresponds to density and concentration respectively.